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**Libro Bianco per la sostenibilità**

Inclusa la dichiarazione dei prodotti ecologici



## SAVE THE CLIMATE: NOW

Come Cobiax si prende cura di clima e risorse.
Non tra 20 anni. Ma **adesso**.

DEUTSCHER MATERIAL EFFIZIENZ PREIS

UMWELTPREIS SCHWEIZ
PRIX SUISSE ENVIRONNEMENT

THIRD-PARTY VERIFIED EPD ISO 14025 and EN 15804
Institut Bauen und Umwelt e.V.

Deutscher Nachhaltigkeitspreis

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wider scopes

L‘otto percento delle emissioni mondiali di $CO_2$ è causato dalla produzione di cemento: 2,8 miliardi di tonnellate di $CO_2$, e questo ogni anno.

Solo in Germania, Austria e Svizzera vengono prodotti ogni anno 42 milioni di tonnellate di cemento. Questo è anche urgentemente necessario, in quanto nuovi edifici energeticamente efficienti permettono di raggiungere gli obiettivi climatici dell'Europa.

Acciaio e calcestruzzo sono tuttavia critici per il clima; la loro produzione implica un alto consumo energetico e una solida emissione di $CO_2$. Una gran parte del calcestruzzo viene utilizzata per realizzare i solai.

Il 20% può essere risparmiato:
Adesso. Subito.
Per il progetto attuale.

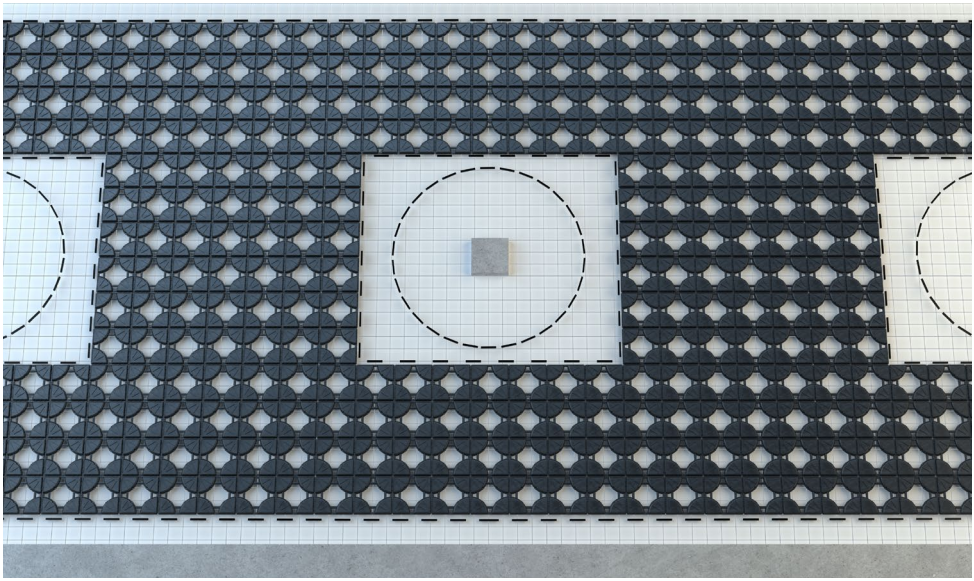
I sistemi a corpo cavo Cobiax riducono il fabbisogno di calcestruzzo di una lastra fino al 35%.

Ci sono molte tecnologie che, nell'ambito dell'edilizia ecologica, propongono molteplici valutazioni per una riduzione sostenibile del consumo di risorse e della produzione di $CO_2$.

La maggior parte di queste tecnologie, tuttavia, o non è pronta per il lancio sul mercato o non si presta alla maggioranza degli usi.

## I prodotti Cobiax sono pronti all'uso, approvati e ampiamente sperimentati.

E: sono fatti di materiale riciclabile al 100%.



Gli elementi edilizi Cobiax sono disponibili per lastre in calcestruzzo da 20 a 80 cm. Dal 50% all'80% circa delle superfici dei solai vengono realizzati con corpi cavi a seconda del carico e del sistema statico.

# Dal 2000: riduzione di 180.000 tonnellate di CO2 grazie a Cobiax.

**600 t**
di calcestruzzo risparmiate

**50 t**
di $CO_2$ risparmiate

**2.250 t**
di calcestruzzo risparmiate

**189 t**
di $CO_2$ risparmiate

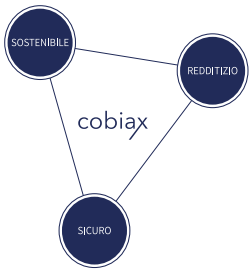
**13.000 t**
di calcestruzzo risparmiate

**1.100 t**
di $CO_2$ risparmiate

# Save the climate: Now

## Cobiax è la tecnologia che **ora** funziona ed è certificata.

Che il progetto edilizio sia già attivo o solo abbozzato - con il sistema a corpo cavo Cobiax lo stesso può essere ora pianificato o ripianificato in modo del tutto sostenibile. Tutti gli attuali studi di progettazione della struttura portante dispongono del Know-how e del software per pianificare o ripianificare rapidamente e senza complicazioni con Cobiax.




Riducete subito l'impatto del $CO_2$ del vostro progetto!

# ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A1*

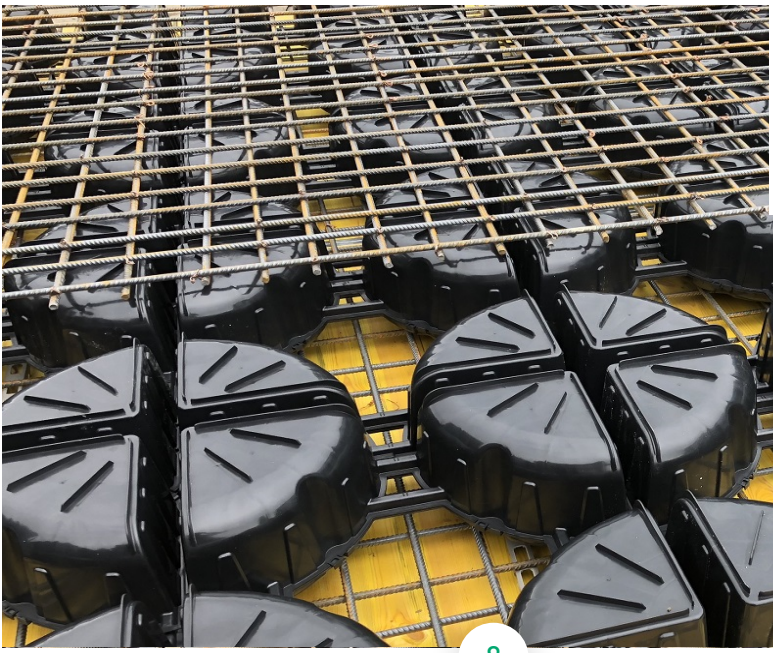
| | |
|---|---|
| Owner of the Declaration | Cobiax Deutschland GmbH |
| Programme holder | Institut Bauen und Umwelt e.V. (IBU) |
| Publisher | Institut Bauen und Umwelt e.V. (IBU) |
| Declaration number | EPD-COB-20210105-IBB1-EN |
| Issue date | 14.07.2021 |
| Valid to | 13.07.2026 |

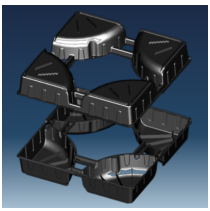
Cobiax CLS structural formers

## Cobiax Deutschland GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com | https://epd-online.com





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## 1. General Information

| Cobiax Deutschland GmbH | Cobiax CLS |
|---|---|
| **Programme holder**<br>IBU – Institut Bauen und Umwelt e.V.<br>Panoramastr. 1<br>10178 Berlin<br>Germany | **Owner of the declaration**<br>Cobiax Deutschland GmbH<br>Am Stadtholz 56<br>33609 Bielefeld,<br>Germany |
| **Declaration number**<br>EPD-COB-20210105-IBB1-EN | **Declared product / declared unit**<br>1m³ in-situ concrete slab featuring Cobiax CLS structural formers |
| **This declaration is based on the product category rules:**<br>Concrete components made of in-situ or ready-mixed concrete, 07.2014<br>(PCR checked and approved by the SVR) | **Scope:**<br>This document applies for in-situ concrete slabs featuring "Cobiax" structural formers. The LCA data is based on long-term project data provided by Cobiax Deutschland GmbH. The data is provided by the production site in Herford operated by the plastics manufacturer of the Heinze Group. The structural formers are manufactured at this location and loaded for transport to the installation site where they are then assembled.<br>The declaration applies for all Cobiax locations and sales partners supplied within a radius of 400 km of the production sites. |
| **Issue date**<br>14.07.2021 | The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.<br>The EPD was created according to the specifications of *EN 15804+A1*. In the following, the standard will be simplified as *EN 15804*. |
| **Valid to**<br>13.07.2026 | **Verification**<br>The standard *EN 15804* serves as the core PCR<br>Independent verification of the declaration and data according to *ISO 14025:2010*<br>☐ internally ☒ externally |
| Dipl. Ing. Hans Peters<br>(chairman of Institut Bauen und Umwelt e.V.) | |
| Dr. Alexander Röder<br>(Managing Director Institut Bauen und Umwelt e.V.)) | Dr.-Ing. Andreas Ciroth<br>(Independent verifier) |

## 2. Product

### 2.1 Product description/Product definition

The declared products comprise in-situ slabs of various component heights with structural formers made of 100% recycled plastic.
CLS structural formers are marketed as half shells and are used for slab thicknesses from 20 to 80 cm.

Use of the product is subject to the respective national specifications at the place of use; in Germany, for example, the state building codes, and the technical specifications based on these guidelines.

### 2.2 Application

Cobiax installation elements are used for manufacturing reinforcing steel slabs from normal concrete in order to deflect vertical and horizontal loads in multi-storey buildings.
The installation elements are used with the aim of reducing the dead-load of the structure as well as reducing the materials used, thereby enabling supporting structures that are more material-efficient.

### 2.3 Technical Data

As the void formers are arranged in the statically ineffective area of the slabs, the mechanical material features of Cobiax voided slabs largely correspond to the features of a solid reinforced concrete slab. Applicable design standards for reinforced concrete elements must be taken into consideration. The Cobiax Technology Manual may be used to provide the appropriate design aids. The parameters indicated in the following tables exclusively refer to solid reinforced concrete slabs.

The void formers can improve the insulating features of the slabs. Owing to the thermal bridge effect of the surrounding concrete, a "worst-case scenario" should however be assumed, and the physical characteristics of a solid reinforced concrete slab applied.
The strength and building physics parameters refer to normal concrete types C20/25 to C45/55 and reinforcing steel BSt 500.

**Construction data**

| Name | Value | Unit |
|---|---|---|
| Thermal conductivity | 2.3 | W/(mK) |
| Water vapour diffusion resistance factor | 80 - 130 | - |
| Sound absorption coefficient * | irrelevant | % |
| Gross density | 2400 | kg/m³ |
| Compressive strength | 20 - 45 | N/mm² |
| Tensile strength | 500 | N/mm² |
| Flexural strength | 23 - 40 | N/mm² |
| Modulus of elasticity | 28800 - 35700 | N/mm² |
| Equilibrium moisture content | 0.13 | % |

*The airborne & impact sound properties of Cobiax voided slabs can be classified as approximating solid slabs as defined by DIN 4109.

Product performance values in terms of its characteristics following the relevant technical determination (no CE marking).

### 2.4 Delivery status

Cobiax CLS structural formers are delivered on pallets as half-shells to the construction site or precast plant and assembled into installation elements on site. The loading dimensions of the pallets and other transport-relevant parameters can be found in the application data sheets.

### 2.5 Base materials/Ancillary materials

Depending on the slab depth, a 1 m³ Cobiax voided slab with CLS structural formers contains the following material volumes, at a 65% coverage with structural formers and a reinforcement ratio of 1.8% by volume:

| | |
|---|---|
| Concrete | 93.5% by mass |
| Reinforcing steel to DIN 488-1 | 5.8% by mass |
| Structural former (polypropylene) | 0.7% by mass |

The product / At least one partial product contains substances on the ECHA Candidate List (15.01.2018) exceeding 0.1% by mass: no.

The product / At least one partial product contains other CMR substances in category 1A or 1B which are not on the List of Candidates, exceeding 0.1% by mass in at least one partial product: No.

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products (No. 528/2012): No.

### 2.6 Manufacture

The majority of Cobiax CLS structural formers are manufactured in an injection-molding process largely in the Herford site. Plastic recyclates in granulated form are fed to the injection molding machine as starting materials and converted into a thermoplastic material with energy supplied in the form of electricity. With the aid of compressed air, half-shell elements are formed, which can be assembled into void formers without further energy input.
The following graphic shows the schematic production flow at the Herford site.

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## Material and energy cycle

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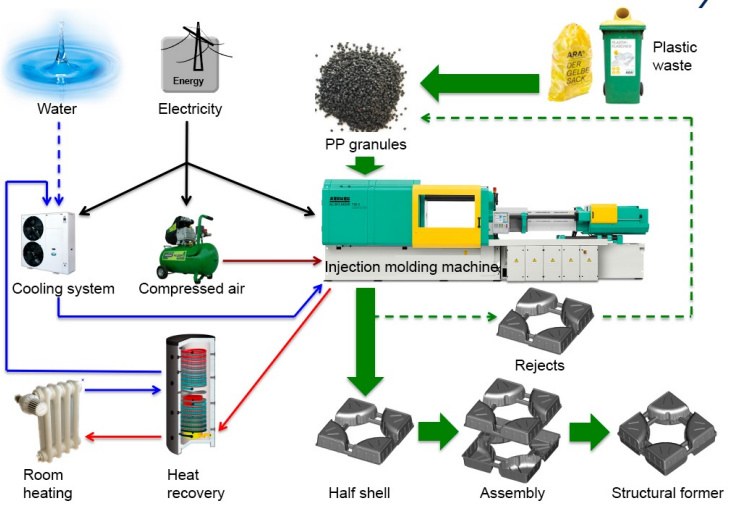


### 2.7 Environment and health during manufacturing

Cobiax CLS structural formers are manufactured in accordance with the national specifications governing industrial and environmental protection.

### 2.8 Product processing/Installation

A Cobiax voided slab can be designed as a "purely in-situ concrete solution" with conventional formwork or in combination with semi-precast elements (element slabs):

**In-situ concrete solution:**

The Cobiax CLS structural formers are assembled directly on site from half-shells stacked on pallets. After installation of the lower reinforcement layer, the CLS installation elements are laid close together without any gaps and fixed in position. This is followed by the installation of the upper reinforcement layer and, if necessary, additional bond reinforcement. In addition to concrete displacement, the structural former also serves as a spacer for the upper reinforcement. The Cobiax CLS structural formers have a uniform delivery format of 0.6 x 0.6 m. When assembling, the specified structural grid must always be observed.
The concrete must be applied and consolidated in the specified quality grade. A maximum grain size of d = 16 mm must be selected. Due to the concrete displacement, an uplift force is generated during the casting process. To prevent the structural former from being uplifted, the individual installation elements must be held down by suitable measures.
This is usually ensured by casting in two working steps.
When casting the first concrete layer, make sure that the installation elements and, if necessary, the bond reinforcement are integrated into it according to the specifications on the installation plan. After stiffening (depending on concrete composition, weather, etc.), this layer fixes the structural formers in position.
The correct height of the structural formers must be checked after the first casting step. If holes are drilled from above into the finished concreted Cobiax voided slab, e.g., for suspending walls, they must be sealed again afterwards. This is to prevent individual void formers from filling with water.
If the areas without void formers are also enclosed in the first layer of concrete, a composite joint must be established and a bond reinforcement included if necessary.

**Semi-precast variant:**

Installation of the semi-precast panels is followed by transverse and joint reinforcement. Then the Cobiax CLS structural formers are placed between the lattice girders on the semi-precast panel. This is followed by application of the upper reinforcement layer.
The concrete must be applied and consolidated in the specified quality grade. A maximum grain size of d = 16 mm must be selected. Due to the concrete displacement, an uplift force is generated during the casting process. To prevent the structural former from being uplifted, the individual installation elements must be held down by suitable measures.
This is usually achieved by connecting the upper reinforcement layer to the upper belt of the lattice girder at specific points. The S-hooks required for this are not included in the scope of delivery of Cobiax Deutschland GmbH.
The required distances can be found in the installation plan.

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### 2.9 Packaging
Cobiax CLS structural formers are delivered to the construction site or precast plant on pallets as half-shells and assembled into structural formers on site. A recyclable LLDPE film is incurred.

### 2.10 Condition of use
No particular features need to be taken into consideration during the period of use.

### 2.11 Environment and health during use
No inter-reactions by hazardous substances of health or environmental relevance can be anticipated.

### 2.12 Reference service life
The reference service life for reinforced concrete voided slabs with a concrete composition in accordance with the limit values outlined in DIN EN 206-1 is at least ≥ 50 years under the respective exposure class / environmental conditions.

### 2.13 Extraordinary effects

**Fire**
A Cobiax voided slab made of CLS structural formers is considered like a solid reinforced concrete slab in terms of fire resistance (according to DIN-EN 13501-1).
Fire protection is regulated for the products in the respective technical approval.

**Fire resistance**

| Name | Value |
|---|---|
| Building material class Structural formers made of PP | B2 |
| Burning droplets Structural formers made of PP | d2 |

The fire resistance class of the entire component is F30-A to F180-A.

If the concrete cover is properly executed, no toxic gases and vapors can be generated in the event of a fire.

BBy complying with the minimum requirement for the concrete overlay, the voided slabs can therefore be considered to consist "in essential parts of non-combustible building materials".

**Water**
No contents which are hazardous to water are used.

**Mechanical destruction**
Contents released in the event of unforeseen mechanical destruction do not represent any environmentally-harmful risk.

### 2.14 Re-use phase
De-constructed slab systems featuring void formers are crushed and sifted conventionally. Results by Darmstadt Technical University (1999) indicated that less than 0.2 mass percentage of non-mineral residue remains in the recycling material which can be reused as an aggregate material. The void former fragments sorted during processing can be reused or recovered energetically following the appropriate treatment as recyclate.

### 2.15 Disposal
After the appropriate treatment, the processed void former waste can be redirected to the material circuit as plastic recyclate or recovered as energy (waste code 17 02 03 as per the European Waste Catalogue). After processing (crushing and sifting), the concrete can be reused as an aggregate material (waste code 17 01 01 as per the European Waste Catalogue).

### 2.16 Further information
Information on the recyclability of in-situ concrete slabs with plastic void formers is based on test report no. 233.1.99 conducted by Darmstadt Technical University dated 09.08.1999.

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More information is available on the Cobiax web site: www.cobiax.com.

## 3. LCA: Calculation rules

### 3.1 Declared Unit

As a declared unit, 1 m3 of reinforced concrete CLS structural former slab system Cobiax® is selected in accordance with the document PCR: Concrete components made of in-situ and ready-mixed concrete, as of 30.11.17.
One cubic meter of Cobiax® slab of the thickness d = 32 cm has a mass of 2,063.1 kg. The conversion from 1 m3 to 1 kg is done with the factor 4.847E-4.
No proportional functional units are declared.

**Declared unit**

| Name | Value | Unit |
|---|---|---|
| Declared unit | 1 | $m^3$ |
| Density (average) | 2063 | $kg/m^3$ |
| Conversion factor to 1 kg (mass per declared unit) | 2063 | $kg/m^3$ |
| Occupancy rate of slabs with CLS structural formers | 65 | % |

The conversion of the declared unit to 1 kg is made considering the actual mass of the reinforced concrete slab with CLS structural formers. Due to the concrete displacement, the mass is lower than for a conventional reinforced concrete slab with a density of 2400 $kg/m^3$.

### 3.2 System boundary

Type of EPD: cradle to plant gate with options
The following modules and processes were taken into consideration:

Production stage A1 to A3:
- Concrete production process including provision of raw materials and transport to the production sit
- Steel production process including provision of raw materials and transport to the production site
- Production of plastic recyclate (allocated as per *ISO 14040*)
- German grid mix for re-granulation of plastic production waste (approx. 60% of the processes plastic) and for production of the void formers including generation and distribution
- Transporting the plastic re-granulate from the manufacturing site to the Cobiax module production site

Transport to construction site A4:
- Transporting the concrete by truck to the construction site
- Transporting the reinforcing steel by truck to the construction site
- Transporting the void formers by truck to the construction site

### 3.3 Estimates and assumptions

Cobiax voided slabs comprise patented Cobiax structural formers and normal concrete with concrete steel reinforcement manufactured in a conventional process. Both the in-situ concrete and reinforcements are provided by regional suppliers.
The LCA data on concrete and reinforcement manufacturing is estimated using the "1.4.01 Concrete C20/25" and "4.1.02 Reinforcement steel" data sets in the Ökobau.dat data base.

On the basis of information supplied by the manufacturer, 90 km were estimated for transporting the plastic re-granulate to the production site for manufacturing the void formers.
An average distance of 30 km for concrete and reinforcement steel and 400 km for the plastic components (CLS structural formers) were estimated for the transport processes from the plant gate to the construction site.

The LCA results published in this EPD represent a Cobiax slab system with a slab thickness of 32 cm, which represents a weighted average slab thickness from the production period from 2015 to 2019. Depending on the slab thickness and the LCA indicator, a deviation of +6 % to -3 % can occur. Thereby, lower slab thicknesses tend to show higher values and higher slab thicknesses lower values. Detailed results can be obtained directly from the manufacturer Cobiax.

### 3.4 Cut-off criteria

All base materials and energy flows for manufacturing CLS structural formers as well as the transport processes from plant gate to plant gate and plant gate to construction site were taken into consideration in the Life Cycle Assessment. Owing to its insignificance, the packaging foil for transporting CLS structural formers has been ignored.

### 3.5 Background data

The volumes on which the LCA is based represent empirical values collated by Cobiax over many years. The background data used for the LCA was taken from Ökobaudat 2020-II.

### 3.6 Data quality

The background data on the manufacturer on which the LCA is based is from 2018. The data sets from the Ökobaudat are from the following reference years:

- 1.4.01 Concrete C20/25: 2018
- 4.1.02 Reinforced steel: 2018
- 9.2.05 Power mix 2015 (D): 2018
- 9.3.01 Trucks: 2018

### 3.7 Period under review

The LCIA data is based on many years of project and product experience on the part of Cobiax Deutschland GmbH. The data originates from 2020, the year the Life Cycle Assessment was drawn up.

### 3.8 Allocation

Allocation concerning plastic manufacturing for the CLS structural formers is depicted below. The plastic used is exclusively processed from recycled material and as a secondary material. In accordance with information provided by the manufacturer, the primary substances are substituted in full. The impact by plastic manufacturing on the environment is therefore fully allocated to the upstream production processes in accordance with EN 15804.
Furthermore, the energy required for re-granulation of plastic recyclate material is also allocated. In accordance with information provided by the manufacturer, 60 % of plastic recyclate is purchased

from the dual system or comprises re-granulated production waste. As re-granulation is necessary for manufacturing the void formers, the requisite energy volume is allocated to the Cobiax slab system boundary.

### 3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to *EN 15804* and the building context, respectively the product-specific characteristics of performance, are taken into account.

The background database used is *Ökobaudat* 2020-II (last revised 03.04.2020). The data sets conform with the EN 15804 standard and are calculated on the basis of GaBi background data.

## 4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios within the context of a building analysis:

**Transport to construction site (A4)**

| Name | Value | Unit |
|---|---|---|
| Litres of fuel per tonne | 2045 | l/100km |
| Transport distance for concrete and reinforced steel | 30 | km |
| Transport distance CLS structural formers | 400 | km |
| Capacity utilisation (including empty runs) | 85 | % |
| Total permissible truck weight | 20-26 | t |

**Reference service life**

| Name | Value | Unit |
|---|---|---|
| Life span (acc. to BSSR, Federal Institute for Research on Building, Urban Affairs and Spatial Development) | >50 | a |

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## 5. LCA: Results

The results of the estimated impact are relative statements which do not make any claims regarding impact category limits, exceeding threshold values, safety levels or risks.

**DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED; MNR = MODULE NOT RELEVANT)**

| PRODUCT STAGE | | | CONSTRUCTION PROCESS STAGE | | USE STAGE | | | | | | | END OF LIFE STAGE | | | | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raw material supply | Transport | Manufacturing | Transport from the gate to the site | Assembly | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport | Waste processing | Disposal | Reuse-Recovery-Recycling-potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | X | MND | MND | MND | MNR | MNR | MNR | MND | MND | MND | MND | MND | MND | MND |

**RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A1: 1 m³ Cobiax structural formers CLS-P-200**

| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Global warming potential | [kg $CO_2$-Eq.] | 2.74E+2 | 6.05E+0 |
| Depletion potential of the stratospheric ozone layer | [kg CFC11-Eq.] | 3.66E-12 | 2.78E-15 |
| Acidification potential of land and water | [kg $SO_2$-Eq.] | 3.78E-1 | 1.47E-2 |
| Eutrophication potential | [kg $(PO_4)^3$-Eq.] | 6.43E-2 | 3.53E-3 |
| Formation potential of tropospheric ozone photochemical oxidants | [kg ethene-Eq.] | 2.96E-2 | -4.96E-3 |
| Abiotic depletion potential for non-fossil resources | [kg Sb-Eq.] | 4.05E-5 | 5.31E-7 |
| Abiotic depletion potential for fossil resources | [MJ] | 1.71E+3 | 8.12E+1 |

**RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A1: 1 m³ Cobiax structural formers CLS-P-200**

| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Renewable primary energy as energy carrier | [MJ] | 6.72E+2 | 1.15E+1 |
| Renewable primary energy resources as material utilization | [MJ] | 0.00E+0 | 0.00E+0 |
| Total use of renewable primary energy resources | [MJ] | 6.72E+2 | 1.15E+1 |
| Non-renewable primary energy as energy carrier | [MJ] | 1.92E+3 | 8.15E+1 |
| Non-renewable primary energy as material utilization | [MJ] | 0.00E+0 | 0.00E+0 |
| Total use of non-renewable primary energy resources | [MJ] | 1.92E+3 | 8.15E+1 |
| Use of secondary material | [kg] | IND | IND |
| Use of renewable secondary fuels | [MJ] | IND | IND |
| Use of non-renewable secondary fuels | [MJ] | IND | IND |
| Use of net fresh water | [m³] | 7.86E-1 | 4.31E-3 |

**RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A1: 1 m³ Cobiax structural formers CLS-P-200**

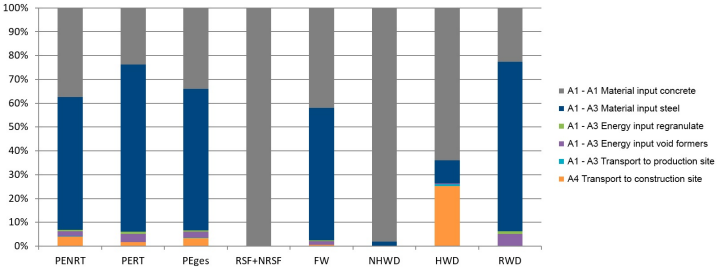
| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Hazardous waste disposed | [kg] | 8.81E-6 | 3.03E-6 |
| Non-hazardous waste disposed | [kg] | 7.07E+1 | 1.46E-2 |
| Radioactive waste disposed | [kg] | 8.26E-2 | 1.08E-4 |
| Components for re-use | [kg] | IND | IND |
| Materials for recycling | [kg] | IND | IND |
| Materials for energy recovery | [kg] | IND | IND |
| Exported electrical energy | [MJ] | IND | IND |
| Exported thermal energy | [MJ] | IND | IND |

## 6. LCA: Interpretation

Total primary energy of 2,835 MJ is required for manufacturing and transporting 1 m3 Cobiax slabs, whereby primary energy requirements are dominated by the provision of reinforcement steel accounting for 59.7 %. Concrete production accounts for 33.1 %, making it, together with steel production, the major contributor to primary energy requirements as well as to the other indicators in the Life Cycle Inventory Analysis. Energy required for re-granulation of plastic recyclate and production of the void formers is very low at 3.5 %. Transport to the place of installation accounts for 3.6 % of total primary energy requirements which also represents a very minor influence.
The following graphic shows life cycle stage results for the indicators in the Life Cycle Inventory Analysis. Primary energy requirements (PERT, PENRT, PE total) and use of fresh water (FW) are taken into consideration as well as the fractions Non Hazardous Waste Disposition (NHWD), Hazardous Waste

Disposition (HWD), Radioactive Waste Disposition (RWD).

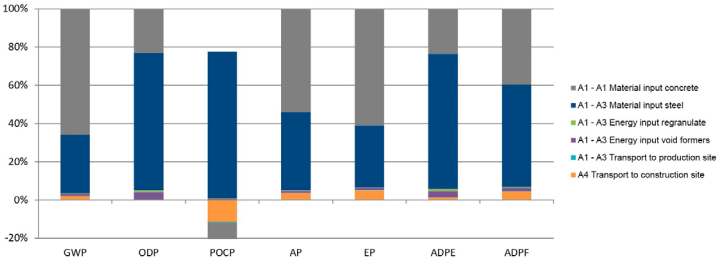
For each stage and indicator, the most contributing processes are listed.




The impact indicators are also significantly influenced by the production process associated with the base materials concrete and steel (92 - 95 %). In the case of ODP (Ozone Depletion Potential), POCP (Photochemical Ozone Creation Potential) and ADPF (Abiotic Depletion Potential of Fossil fuels) in particular, the steel component is dominant for flexural and supplementary reinforcement. At 0.1 - 5.2 %, transport of the base materials to the installation site has only a minimum influence on the impact indicators.

The electricity input for the conversion of the plastic regranulates and the production of void formers also has only a very small influence on the impact potentials with a share of less than 1.5 % (deviations: 5 % for ODP and 4.2 % for ADPE - potential for abiotic degradation of non-fossil resources).

The following graphic life cycle stages and the the dominating processes based on their shares in the impact analysis indicators.




## 7. Requisite evidence

Cobiax advises planners and building contractors of reinforced voided slabs, and supplies construction sites with CLS structural formers. The company does not however manufacture the flexural reinforcement layers or concrete supplied as in-situ concrete by local suppliers. The respective concrete suppliers are responsible for this evidence.

### 7.1 Radioactivity

Cobiax voided slabs largely comprise concrete and steel (99.5% of mass) and recycled plastic. Concrete displays a low level of natural radioactivity. Structural steel can have a slightly increased level since 1940. It can be assumed, therefore, that Cobiax voided slabs are comparable with standard reinforced concrete slabs.

### 7.2 Leaching

Cobiax void formers are integrated in concrete and are not directly weathered. Leaching performance is not, therefore, of relevance.

### 7.3 VOC emissions

No VOC emissions can be anticipated by the primary components (concrete and steel) of voided slabs. The void formers are made from hard recycled plastic and are interlocked. The plastic elements are also integrated in the reinforced concrete and do not come into contact with ambient air with the result that VOC emissions can be regarded as irrelevant.

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## 8. References


**General programme instructions**
For generating EPDs at Institut Bauen und Umwelt e.V. (IBU), 10/2015, www.ibu-epd.com

**ISO 14025**
DIN EN ISO 14025:2011-10, Environmental designations and declarations – Type III Environmental Declarations – Basic principles and processes

**EN 15804**
EN 15804:2012-04+A1 2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

**ISO 14040**
DIN EN ISO 14040:2006, Environmental Management – Life Cycle Assessment – Principles and framework

**ISO 14056**
DIN EN ISO 10456:2010, Building materials and products – Hygrothermal properties – Tabulated design values

**EN 1992-1-1**
DIN EN 1992-1-1:2011-01, Eurocode 2: Design of concrete structures

**DIN 4108-4**
DIN 4108-4:2020-11, Thermal protection and saving energy in buildings – Part 4: Hygrothermal design values

**DIN 488-1**
DIN 488-1:2009-08, Reinforcing steels – Part 1: Grades, properties, marking

**DIN 4109-1**
DIN 4109-1:2018-01, Sound insulation in buildings – Part 1: Minimum requirements

**EN 206**
**DIN EN 206:2021-06**, Concrete – Specification, performance, production and conformity

**ISO 9001**
DIN EN ISO 9001:2015-11, Quality management systems – Requirements

**EN 13501-1**
DIN EN 13501-1:2019-05, Fire classification of construction products and building elements

**DIBt-Z-15.1-282**, General type approval for "COBIAX" void flat plate slabs, Deutsches Institut für Bautechnik, 2015

**DIBt-Z-15.1-307**, General type approval for "COBIAX SLIM-LINE" void flat plate slabs, Deutsches Institut für Bautechnik, 2018

**DIBt-Z-15.1-352**, General type approval for "COBIAX CLS" void flat plate slabs, Deutsches Institut für Bautechnik, 2021

**Test Report No. 233.1.99**
Recyclability of concrete slabs with hollow plastic spheres, Darmstadt Technical University, 1999

**COBIAX Technology Manual**
Cobiax Deutschland GmbH (pub.): Technology Manual; DE version, September 2017

**Product Category Rules for Construction Products, Part A:**
Institut Bauen und Umwelt e.V., Berlin (pub.): Product category rules (PCR) for building-related products and services, Part A: Calculation rules for the Life Cycle Assessment and requirements on the Project Report, 04-2017, www.bau-umwelt.de

**PCR: Concrete components made of in-situ and ready-mixed concrete**
Product category rules for building-related products and services, Part B: Requirements on the EPD for concrete components made of in-situ or ready-mixed concrete, Berlin: Institut Bauen und Umwelt e.V. (pub.), 11-2017

**European Waste Catalogue**
Administrative regulation 2000/532/EC: Commission decision dated 3 May 2000 substituting decision 94/3/EC on a waste index as per Article 1a) of Council Guideline 75/442/EEC on waste and Council decision 94/904/EC on an index of hazardous waste according to Article 1, paragraph 4 of Guideline 91/689/EEC on hazardous waste.

**AgBB**
German-Committee for health-related evaluation of building products

**Ökobaudat**
German database for building materials (http://www.nachhaltigesbauen.de/oekobaudat/): Federal Ministry of the Interior, for Construction and Home Affairs
Press, Online Communications, Public Relations Department
Alt-Moabit 140
D-10557 Berlin

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# ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

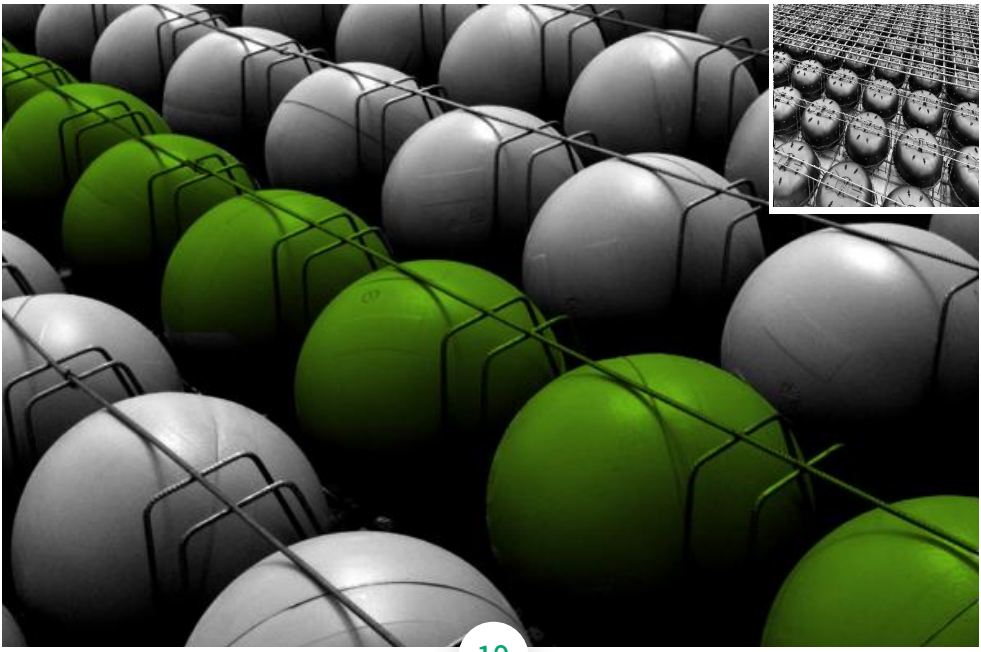
| | |
|---|---|
| Owner of the Declaration | **Cobiax Deutschland GmbH** |
| Programme holder | Institut Bauen und Umwelt e.V. (IBU) |
| Publisher | Institut Bauen und Umwelt e.V. (IBU) |
| Declaration number | EPD-COB-20180135-IAD1-EN |
| Issue date | 29.10.2018 |
| Valid to | 28.10.2023 |

Cobiax void former modules

## Cobiax Deutschland GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com



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## 1. General Information

**Cobiax Deutschland GmbH**

**Programme holder**
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

**Declaration number**
EPD-COB-20180135-IAD1-EN

**This declaration is based on the product category rules:**
Concrete components made of in-situ or ready-mixed concrete, 07.2014
(PCR checked and approved by the SVR)

**Issue date**
29.10.2018

**Valid to**
28.10.2023

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dipl. Ing. Hans Peters
(Head of Board IBU)

Cobiax void former modules

**Owner of the declaration**
Cobiax Deutschland GmbH
Am Stadtholz 56
33609 Bielefeld

**Declared product / declared unit**
1m³ in-situ concrete slabs featuring Cobiax void former modules from the Slim-Line / Slim-Line-Click and Eco-Line ranges.

**Scope:**
This document applies for in-situ concrete slabs featuring "COBIAX" void former modules. The LCA data is based on long-term project data provided by Cobiax Deutschland GmbH. The data is provided by the production sites in Herford and Remptendorf operated by the plastics manufacturers of the Heinze Group. The void former modules are manufactured at these locations and loaded for transport to the installation site where they are then assembled. The Declaration applies for all COBIAX locations and sales partners supplied within a radius of 400 km of the production sites.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

**Verification**

| |
|---|
| The standard /EN 15804/ serves as the core PCR |
| Independent verification of the declaration and data according to /ISO 14025:2010/ |
| ☐ internally ☒ externally |

Matthias Schulz
(Independent verifier appointed by SVR)

## 2. Product

### 2.1 Product description / Product definition

The declared products comprise in-situ slabs of various component heights with void former modules made of grid-shaped reinforcing steel support cages and integrated spherical void formers made of 100% recycled plastic.
The void former modules are marketed as Eco-Line (spheres) and Slim-Line (half-shells). Slim-Line is used for slab thicknesses of 20-46 cm and Eco-Line for 40-75 cm.

The product is not subject to any EU legal harmonising specifications and does not, therefore, bear a CE mark. Use of the product is subject to the respective national specifications at the place of use; in Germany, for example, the state building codes and the technical specifications based on these guidelines.

### 2.2 Application

COBIAX modules are used for manufacturing reinforcing steel slabs from normal concrete in order to deflect vertical and horizontal loads in multi-storey buildings.
The void former modules are used with the aim of reducing the dead-load of the structure as well as reducing the materials used, thereby enabling more material-efficient supporting structures.

### 2.3 Technical Data

As the void formers are arranged in the statically ineffective area of the slabs, the mechanical material features of COBIAX slabs largely correspond with the features of a solid reinforced concrete slab. The applicable design standards for reinforced concrete elements must be taken into consideration. The COBIAX Technology Manual also provides the appropriate design aids. The parameters indicated in

the following tables exclusively refer to solid reinforced concrete slabs.
The void formers can improve the insulating features of the slabs. Owing to the thermal bridge effect of the surrounding concrete, a "worst-case scenario" should however be assumed and the physical characteristics of a solid reinforced concrete slab applied.
The strength and building physics parameters refer to normal concrete types C20/25 to C45/55 and reinforcing steel BSt 500.
*In accordance with the P322/06 statement by ITA Ingenieurgesellschaft für technische Akustik mbH on sound protection offered by Cobiax void flat plate slabs, the air and impact sound protection of Cobiax slabs can be classified as being close to solid slabs within the meaning of Tables 11,12 & 16, Supplement 1 of the DIN 4109 standard.

**Construction data**

| Name | Value | Unit |
|---|---|---|
| Thermal conductivity conductivity to DIN EN 12524 | 2.3 | W/(mK) |
| Water vapour diffusion resistance factor to DIN EN 12524 | 80/130 | - |
| Sound absorption coefficient * | irrelevant | % |
| Gross density | 2400 | kg/m³ |
| Compressive strength (cylindrical compressive strength of concrete to DIN 1045) | 20 - 45 | N/mm² |
| Tensile strength (nominal yield strength of reinforcement to DIN 1045) | 500 | N/mm² |
| Flexural strength (concrete to DIN 1045) | 23 - 40 | N/mm² |
| Modulus of elasticity (concrete to DIN 1045) | 28800 - 35700 | N/mm² |
| Equilibrium moisture content to DIN 4108-4 | 0.13 | % |

Product performance values in terms of its characteristics following the relevant technical determination

### 2.4 Delivery status

Void former modules made of reinforcing steel and hollow cores are supplied in the form of cages of 2.5 metres in length, 11.5 to 34.5 cm (Slim-Line) and 19.0 to 46.2 cm (Eco-Line) high, up to 50 cm wide and weighing up to 13.3 kg.
In-situ concrete and reinforcement modules are delivered separately.
The void former modules can also be fitted with concrete semi-precast elements. The semi-precast slabs, void former modules, in-situ concrete, and additional reinforcements are delivered separately.

### 2.5 Base materials / Ancillary materials

Depending on the slab depth, 1m³ COBIAX void flat plate slabs contains the following material volumes when fitted with 65% void formers and a reinforcement angle of 1.8%:

| | |
|---|---|
| Concrete | 93.4% by mass |
| Reinforcing steel to DIN 488-1 | 6.1% by mass |
| Void former (PEHD or PP) | 0.5% by mass |

The product / At least one partial product contains substances on the List of Candidates (15.01.2018) exceeding 0.1% by mass: No.

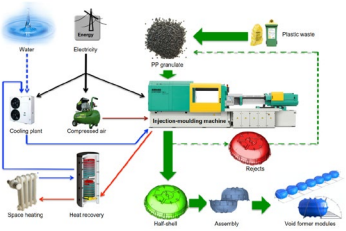
The product / At least one partial product contains other CMR substances in category 1A or 1B which are not on the List of Candidates, exceeding 0.1% by mass in at least one partial product: No.

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products (No. 528/2012): No.

### 2.6 Manufacture

Slim-Line void former modules are manufactured in an injection-moulding process largely in the Herford plant. As a base material, plastic recyclate in granulated form is fed into the injection-moulding machine and converted into a thermoplastic material with energy supplied in the form of electricity. Compressed air is used to form semi-precast elements (half-shells) which can be assembled without any additional energy supply to form void formers before being fitted inside the reinforcement elements.

The following graphic depicts the schematic production process at the Herford plant.




Eco-Line void former modules are manufactured in a blow-moulding process at the Remptendorf plant. As at the Herford plant, plastic recyclate in granulated form undergoes thermoplastic conversion and blow-moulding to form finished void formers, dispensing with the intermediate step of half-shell assembly.

### 2.7 Environment and health during manufacturing

COBIAX void formers are manufactured in accordance with the national specifications governing industrial and environmental protection.

### 2.8 Product processing/Installation

COBIAX flat slabs can be designed as a "purely in-situ concrete solution" with conventional formwork or in combination with semi-precast elements (element slabs):

In-situ concrete solution:
COBIAX void former modules are unloaded from the truck using a construction site crane. After installation of the lower flexural reinforcement layer, the modules are laid using the COBIAX mounting aid and fixed in place. This is followed by installation of the upper reinforcement layer. Apart from concrete displacement,

the void former modules also serve as spacers for the upper reinforcement layer. COBIAX void former modules are approx. 2.50 metres long and are shortened in accordance with the dimensions indicated on the installation plan. The specified spherical grid must always be observed during assembly.

The concrete must be applied and consolidated in the specified quality grade. For void formers of 10 to 31.5 cm in height, d = 16 mm should be selected as the maximum grain size. Concrete displacement gives rise to a buoyant force during the concrete pouring process. Avoid buoyancy on the part of the void formers by applying suitable measures to hold the individual void former modules down. This is achieved by concreting in 2 layers. When pouring the first concrete layer, ensure that the lower longitudinal rods of the cage modules are enclosed in accordance with the installation plan. After stiffening (also dependent on the concrete composition, weather etc.), this layer secures the COBIAX void former modules downwards. The correct height of the void former modules must be checked after the first concreting step.
If holes are drilled through the top of the concreted COBIAX void flat plate slabs, e.g. for suspending walls, they must be sealed again afterwards. This aims to prevent individual void formers filling with water.
If the areas without void formers are also enclosed in the first layer of concrete, a composite joint must be established and a bond reinforcement included if necessary.

Semi-precast variant:
Installation of the semi-precast elements is followed by transverse and joint reinforcement. Then the COBIAX installation aid is used to position the COBIAX void former modules between the cage modules on the semi-precast element. This is followed by application of the upper reinforcement layer.
The concrete must be applied and consolidated in the specified quality grade. For void formers of 10 to 31.5 cm in height, d = 16 mm should be selected as the maximum grain size. Concrete displacement gives rise to a buoyant force during the concrete pouring process. Avoid buoyancy on the part of the void formers by applying suitable measures to hold the individual void former modules down. This is achieved by spot-connecting the upper reinforcement layer with the upper belt of the cage modules. The S-hooks required for this are included in the scope of supply by Cobiax Deutschland GmbH. Please refer to the installation plan for the requisite spacings.

**2.9 Packaging**
The finished COBIAX void former modules are packed in bundles without packaging materials for delivery to the construction site.
On delivery of the semi-precast elements (half-shells) for Slim-Line void formers, recyclable LLDPE foil is incurred.

**2.10 Condition of use**
No particular features need to be taken into consideration during the period of use.

**2.11 Environment and health during use**
No inter-reactions by hazardous substances of health or environmental relevance can be anticipated.

**2.12 Reference service life**
The reference service life for reinforced concrete hollow slabs with a concrete composition in accordance with the limit values outlined in DIN EN 206 is at least ≥ 50 years under the respective exposure class / environmental conditions.

Influences on ageing when the recognised rules of technology are applied.

**2.13 Extraordinary effects**

**Fire**
A COBIAX void flat plate slab is regarded as a solid reinforced concrete slab in terms of technical fire safety.
Product fire safety is regulated by the respective approval.

**Fire protection**

| Name | Value |
|---|---|
| Building material class for reinforced concrete | A |
| Building material class for void formers | min. B2 |
| Fire-resistance class or component as a whole | F30-A - F180-A |

Based on the test certificate and the technical fire safety risk assessment by MFPA Leipzig

Where the concrete covering is applied correctly, no toxic gases or vapours can arise in the event of a fire.

**Water**
No contents which are hazardous to water are used.

**Mechanical destruction**
Contents released in the event of unforeseen mechanical destruction do not represent any environmentally-harmful risk.

### 2.14 Re-use phase
De-constructed slab systems featuring void formers are crushed and sifted conventionally. Results by Darmstadt Technical University (1999) indicated that less than 0.2 mass percentage of non-mineral residue remains in the recycling material which can be reused as an aggregate material. The void former fragments sorted during processing can be reused or recovered energetically following the appropriate treatment as recyclate.

### 2.15 Disposal
After the appropriate treatment, the processed void former waste can be redirected to the material circuit as plastic recyclate (HD polyethylene) or recovered as energy (waste code 17 02 03 as per the European Waste Catalogue).
After processing (crushing and sifting), the concrete can be reused as an aggregate material (waste code 17 01 01 as per the European Waste Catalogue).

### 2.16 Further information
Information on the recyclability of in-situ concrete slabs with plastic void formers is based on test report no. 233.1.99 conducted by Darmstadt Technical University dated 09.08.1999.

More information is available on the COBIAX web site: www.cobiax.com.

## 3. LCA: Calculation rules

### 3.1 Declared Unit
This Declaration refers to the production of 1m³ "Cobiax" void flat plate slabs comprising 65% void formers and a degree of reinforcement accounting for 1.8 per cent by volume. The Life Cycle Assessment was conducted for both types of void former (Slim-Line and Eco-Line) and various slab depths of 20 to 60 cm. The LCA results of the less ecologically favourable slab depth of 20 cm and Slim-Line 100 void formers are applied for the Declaration. As a “worst-case scenario”, the EPD is therefore also representative for slab depths of 20 to 60 cm.

**Declared unit**

| Name | Value | Unit |
|---|---|---|
| Declared unit | 1 | m³ |
| Density (mass per m³) | 2167 | kg/m³ |
| Percentage of reinforcement | 1,8 | % by volume |
| Conversion factor to 1 kg | 0.000461 | - |
| Percentage of void formers | 65 | % |

The declared unit is converted to 1 kg taking consideration of the actual mass of the reinforced concrete slabs featuring void former modules. Owing to concrete displacement, the mass is lower than for conventional reinforced concrete slabs with a density of 2400 kg/m³.

### 3.2 System boundary
Type of EPD: cradle to plant gate with options
The following modules and processes were taken into consideration:

Production stage A1 to A3:
- Concrete production process including provision of raw materials and transport to the production site
- Steel production process including provision of raw materials and transport to the production site
- Production of plastic recyclate (allocated as per ISO 14040)
- German power mix for re-granulation of plastic production waste (approx. 60% of the processes plastic) and for production of the void formers including generation and distribution
- Transporting the plastic re-granulate from the manufacturing site to the Cobiax module production site
- Transporting the reinforcement cages from the manufacturing site to the Cobiax module production site

Transport to construction site A4:
- Transporting the concrete by truck to the construction site
- Transporting the reinforcing steel by truck to the construction site
- Transporting the void formers by truck to the construction site

### 3.3 Estimates and assumptions
COBIAX void flat plate slabs comprise patented COBIAX void former modules and normal concrete with concrete steel reinforcement manufactured in a conventional process. Both the in-situ concrete and reinforcements are provided by regional suppliers. The LCA data on concrete and reinforcement manufacturing is estimated using the "1.4.01 Concrete C20/25" and "4.1.02 Reinforcement steel" data sets in the Ökobau.dat data base.

On the basis of information supplied by the manufacturer, 110 km were estimated for transporting the plastic re-granulate to the production site for manufacturing the void formers.
An average distance of 30 km for concrete and reinforcement steel and 400 km for the plastic components and reinforcement cages were estimated for the transport processes from the plant gate to the construction site.

The LCA results published in this EPD represent a COBIAX slab system with a slab depth of 20 cm which represents the least ecological version of COBIAX slabs. Some higher slab systems have up to 7% less impact on the environment. The detailed results can be requested directly from COBIAX.

### 3.4 Cut-off criteria
All base materials and energy flows for manufacturing COBIAX void flat plate slabs as well as the transport processes from plant gate to plant gate and plant gate to construction site were taken into consideration in the Life Cycle Assessment. Owing to its insignificance, the

packaging foil for transporting Slim-Line half-shells has been ignored.

### 3.5 Background data

The volumes on which the LCA is based represent empirical values collated by COBIAX over many years. The background data used for the LCA was taken from the Ökobau.dat.

### 3.6 Data quality

The background data on the manufacturer on which the LCA is based is from 2018. The data sets from the Ökobau.dat are from the following reference years:

- 1.4.01 concrete C20/25: 2016
- 4.1.02 reinforced steel: 2016
- 9.2.05 power mix 2015 (D): 2016
- 9.3.01 truck: 2016

The data sets originate from the Ökobau.dat data base (valid: 2018). The data sets are representative for 2019.
They do not provide any details on secondary fuels in the LCIA.

### 3.7 Period under review

The LCIA data is based on many years of project and product experience on the part of COBIAX Deutschland GmbH. The data originates from 2017/2018, the years the Life Cycle Assessment was drawn up.

### 3.8 Allocation

Allocation concerning plastic manufacturing for the void formers is depicted below. The plastic used is exclusively processed from recycled material and as a secondary material. In accordance with information provided by the manufacturer, the primary substances are substituted in full. The impact by plastic manufacturing on the environment is therefore fully allocated to the upstream production processes in accordance with EN 15804.

Furthermore, the energy required for re-granulation of plastic recyclate material is also allocated. In accordance with information provided by the manufacturer, 60% of plastic recyclate is purchased from the dual system or comprises re-granulated production waste. As re-granulation is necessary for manufacturing the void formers, the requisite energy volume is allocated to the COBIAX slab system boundary.

### 3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

The background data base used is /Ökobau.dat/ 2017-I (last revised 27.11.2017). The data sets conform with the DIN EN 15804 standard and are calculated on the basis of GaBi background data.

## 4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios within the context of a building analysis:

**Transport to construction site (A4)**

| Name | Value | Unit |
|---|---|---|
| Litres of fuel per tonne | 2.045 | l/100km |
| Transport distance for concrete and reinforced steel | 30 | km |
| Transport distance for void former modules | 400 | km |
| Capacity utilisation (including empty runs) | 85 | % |
| Total permissible truck weight | 20 - 26 | t |

## 5. LCA: Results

The results of the estimated impact are relative statements which do not make any claims regarding impact category limits, exceeding threshold values, safety levels or risks.

**DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)**

| PRODUCT STAGE | | | CONSTRUCTION PROCESS STAGE | | USE STAGE | | | | | | | END OF LIFE STAGE | | | | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raw material supply | Transport | Manufacturing | Transport from the gate to the site | Assembly | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport | Waste processing | Disposal | Reuse-Recovery-Recycling-potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | X | MND | MND | MND | MNR | MNR | MNR | MND | MND | MND | MND | MND | MND | MND |

**RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ COBIAX void flat plate slabs**

| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Global warming potential | [kg $CO_2$-Eq.] | 298.68 | 4.53 |
| Depletion potential of the stratospheric ozone layer | [kg CFC11-Eq.] | 4.63E-10 | 8.96E-13 |
| Acidification potential of land and water | [kg $SO_2$-Eq.] | 5.51E-1 | 1.08E-2 |
| Eutrophication potential | [kg $(PO_4)^3$-Eq.] | 7.41E-2 | 2.53E-3 |
| Formation potential of tropospheric ozone photochemical oxidants | [kg ethene-Eq.] | 4.78E-2 | -3.15E-3 |
| Abiotic depletion potential for non-fossil resources | [kg Sb-Eq.] | 3.59E-4 | 4.84E-7 |
| Abiotic depletion potential for fossil resources | [MJ] | 1861.62 | 61.39 |

**RESULTS OF THE LCA - RESOURCE USE: 1 m³ COBIAX void flat plate slabs**

| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Renewable primary energy as energy carrier | [MJ] | 619.65 | 41.36 |
| Renewable primary energy resources as material utilization | [MJ] | 0.00 | 0.00 |
| Total use of renewable primary energy resources | [MJ] | 619.65 | 41.36 |
| Non-renewable primary energy as energy carrier | [MJ] | 2112.36 | 61.62 |
| Non-renewable primary energy as material utilization | [MJ] | 0.00 | 0.00 |
| Total use of non-renewable primary energy resources | [MJ] | 2112.36 | 61.62 |
| Use of secondary material | [kg] | 9.00 | 0.00 |
| Use of renewable secondary fuels | [MJ] | IND | IND |
| Use of non-renewable secondary fuels | [MJ] | IND | IND |
| Use of net fresh water | [m³] | 8.52E-1 | 4.78E-3 |

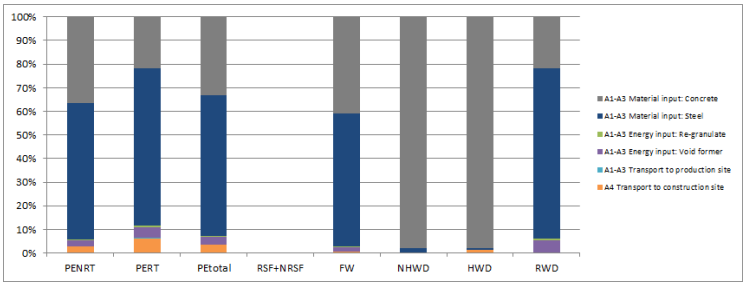
**RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ COBIAX void flat plate slabs**

| Parameter | Unit | A1-A3 | A4 |
|---|---|---|---|
| Hazardous waste disposed | [kg] | 2.59E-4 | 3.86E-6 |
| Non-hazardous waste disposed | [kg] | 7.46E+1 | 4.73E-3 |
| Radioactive waste disposed | [kg] | 9.93E-2 | 9.32E-5 |
| Components for re-use | [kg] | 0.00 | 0.00 |
| Materials for recycling | [kg] | 0.00 | 0.00 |
| Materials for energy recovery | [kg] | 0.00 | 0.00 |
| Exported electrical energy | [MJ] | 0.00 | 0.00 |
| Exported thermal energy | [MJ] | 0.00 | 0.00 |

## 6. LCA: Interpretation

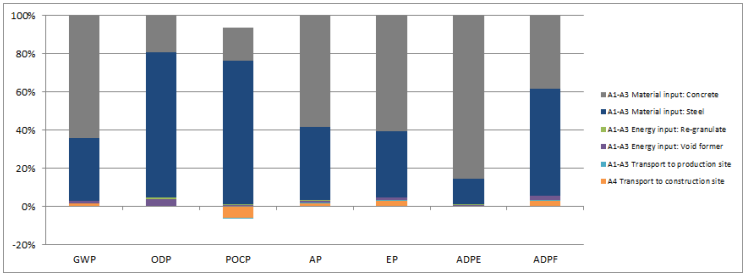
Total primary energy of 2,835 MJ is required for manufacturing and transporting 1m³ COBIAX slabs, whereby primary energy requirements are dominated by the provision of reinforcement steel accounting for 59.7%. The percentage of concrete production accounts for 33.1%, making it and steel production the major influential factors for primary energy requirements as well as for the other indicators in the Life Cycle Inventory Analysis. Energy required for re-granulation of plastic recyclate and production of the void formers is very low at 3.5%. Transport to the place of installation accounts for 3.6% of total primary energy requirements which also represents a very minor influence.

The following graphic depicts the dominating process factors for the indicators in the Life Cycle Inventory Analysis, whereby primary energy requirements (PERT, PENRT, PE total) and use of fresh water (FW) are taken into consideration as well as the waste fractions (NHWD, HWD, RWD).




The impact indicators are also significantly influenced by the production process associated with the base materials concrete and steel (90-97%). In the case of ODP, POCP and ADPF in particular, the steel component is dominant for flexural reinforcement and hollow reinforcement cages.
At 0.1-3%, transport of the base materials to the installation site has only a minimum influence on the impact indicators. Transport only has a significant impact of approx. 7% on impact potential in the case of the Photochemical Ozone Creation Potential (POCP). The electricity required for converting plastic re-granulate and manufacturing the void formers only has a very minor influence on the impact potentials, accounting for less than 2% (5% of ODP).

The following graphic depicts the dominating process factors on the basis of their shares in the impact analysis indicators:




## 7. Requisite evidence

COBIAX advises planners and building contractors of reinforced steel void flat plate slabs, and supplies construction sites with void former modules. The company does not however manufacture the flexural reinforcement layers or concrete supplied as in-situ concrete by local suppliers. The respective concrete suppliers are responsible for this evidence.

7.1 Radioactivity
Cobiax void flat plate slabs largely comprise concrete and steel (99.5% of mass) and recycled plastic. Concrete displays a low level of natural radioactivity. Structural steel can have a slightly increased level since 1940. It can be assumed, therefore, that Cobiax void flat plate slabs are comparable with standard reinforced concrete slabs.

7.2 Leaching
Cobiax void formers are integrated in concrete and are not directly weathered. Leaching performance is not, therefore, of relevance.

7.3 VOC emissions
No VOC emissions can be anticipated by the primary components (concrete and steel) of void flat plate slabs. The void formers are made from hard recycled plastic and are interlocked. The plastic elements are also integrated in the reinforced concrete and do not come into contact with ambient air with the result that VOC emissions can be regarded as irrelevant.

## 8. References

cobiax

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**AgBB:** German-Committee for health-related evaluation of building products

**Ökobau.dat:** German data base for building materials (http://www.nachhaltigesbauen.de/oekobaudat/)

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